C LEVEL PROBLEMS

1. Hex FAC3 in binary is:

   1111 1010 1100 0011

2. Hex FAC3 as an unsigned decimal is:

   15(16^3) + 10(16^2) + 12(16^1) + 3(16^0) = 61440 + 2560 + 192 + 3 = 64195

3. Hex FAC3 as a signed decimal is:

   0 * (16^3) + 5(16^2) + 3(16^1) + 13 = -(1280 + 48 + 13) = -1341

4. Hex 0064 in binary is:

   0000 0000 0110 0100

5. Hex 0064 as an unsigned decimal is:

   0 + 0 + 6(16) + 4 = 100

6. Hex 0064 as a signed decimal is:

   Still 100. None of the most significant bits indicate a change in sign(all 0).

7. Hex 8000 in binary is:

   1000 0000 0000 0000

8. Hex 8000 as an unsigned decimal is:

   8(16^3) = 32768

9. Hex 8000 as a signed decimal is:

   1000 0000 0000 0000 MSB negative, so flipped to 0111 1111 1111 1111, added 1 to produce (-)1000 0000 0000 0000, or -32768.

10. Decimal 8000 encoded in 16-bits (unsigned) is in hex:

    1F40

11. Decimal 8000 encoded in 16-bits (signed) is in hex:

    1F40

12. Decimal -11 encoded in 16-bits (signed) is in hex:

FFF5

13. Decimal -32717 encoded in 16-bits (signed) is in hex:

8033

14. Binary 10111101 in hex is:

BD

15. Binary 1011110100000001 as an unsigned decimal is:

2^15 + 2^ 13 + 2^12 + 2^11 + 2^10 + 2^8 + 2^0 = 32768 + 8192 + 4096 + 2048 + 1024 + 1 = 48385

16. [FIXED] Binary 1011110100000001 as a signed decimal is:

-(2^ 13 + 2^12 + 2^11 + 2^10 + 2^8 + 2^0) = -(8192 + 4096 + 2048 + 1024 + **256** + 1) = **-15617**

17. If we had 20-bit registers, the smallest signed decimal integer value would be:

-524288

18. If we had 20-bit registers, the largest signed decimal integer value would be:

2^19 - 1 or 524287.

19. The modular sum of 16-bit hex values 3511 + 4FFC is:

850D

20. The saturated sum of 16-bit hex values 3511 + 4FFC is:

850D

21. The 16-bit operation 0x3511 + 0x4FFC has a carry (Y or N):

No. The most significant place does not result in a value greater than F.

22. The 16-bit operation 0x3511 + 0x4FFC has a overflows (Y or N):

Yes. 3 and 4 signed are positive, but result in an negative number because the most significant bit of 850D is 1.

B LEVEL PROBLEMS

Complete all the C-level problems plus the following:

1. The modular sum of 16-bit hex values 6159 + F702 is:

   585B(carry 1)

2. The saturated sum of 16-bit hex values 6159 + F702 is:

   FFFF.

3. The 16-bit operation 0x6159 + 0xF702 has a carry (Y or N):

   Yes.

4. The 16-bit operation 0x6159 + 0xF702 has a overflows (Y or N):

   No.

5. The modular sum of 16-bit hex values EEEE + C00C is:

   AEFA(carry 1).

6. The saturated sum of 16-bit hex values EEEE + C00C is:

   FFFF.

7. The 16-bit operation 9EEE + AB0C has a carry (Y or N):

   Yes.

8. The 16-bit operation 9EEE + AB0C has a overflows (Y or N):

   Yes. Adding modularly, this sum results in 49FA, which is positive, whereas the addends are both signed negative numbers.

9. The negation of 16-bit word 0xB00F is:

   0x4FF1.

10. The negation of 16-bit word 0x2232 is:

    0xDDCE.

11. The negation of 16-bit word 0x8000 is:

    0x8000

12. The negation of 32-bit word 0xFFF329BA is:

0x000CD646

13. 96.03125 as a 32-bit float, in hex is:

    0x42c01000

14. -16777216 as a 32-bit float, in hex is:

    0xCB800000

15. Hex 43700000, when interpreted as an IEEE-754 pattern, is in decimal:

    11110000 = 128 + 64 + 32 + 16 = 240

16. Hex C0FF0000, when interpreted as an IEEE-754 pattern, is in decimal:

    111.111 = 7. (1/2) + (1/4) + (⅛) + (1/16) + (1/32) = -7.96875

A LEVEL PROBLEMS

Complete all the C-level AND B-level problems plus the following:

1. The largest finite IEEE-754 single precision float, in hex is:

   0111 1111 0111 1111 1111 1111 1111 1111 = 7F7FFFFF(exponent segment can't be 111 1111 1, results in infinity)

2. The smallest finite IEEE-754 single precision float, in hex is:

   1111 1111 0111 1111 1111 1111 1111 1111 = FF7FFFFF

3. The largest nonzero negative IEEE-754 single precision float, in hex is:

   1000 0000 0000 0000 0000 0000 0000 0001 = 0x80000001

4. The smallest nonezero positive IEEE-754 single precision float, in hex is:

   0000 0000 0000 0000 0000 0000 0000 0001 = 0x00000001

5. -5.125 X 2^{90} as a 32-bit float, in hex is:

   1110 1101 1010 0100 0000 0000 0000 0000 = 0xEDA40000

6. **[FIXED]**2^{-138} as a 32-bit float, in hex is:

   0111 1010 1000 0000 0000 0000 0000 0000 = 0x7A800000 / **0x00000800**

7. **[FIXED]**1.5 X 2^{-143} as a 32-bit float, in hex is:

1111 1000 0100 0000 0000 0000 0000 0000 = 0xF8400000 / **0x00000060**

8. OPTIONAL — Try this for a challenge, a puzzle, or the experience:
   Hex C059000000000000, when interpreted as an IEEE-754 pattern, is in decimal:

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